Washington State Department of Transportation

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http://www.wsdot.wa.gov/accountability/Archives/GrayNotebookDec-02.pdf

Improving Highway Safety:
Cable Median Barrier

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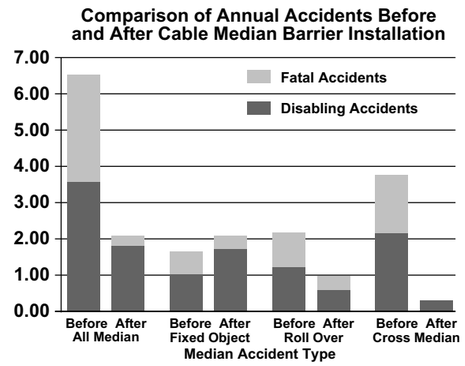
"We were recently involved in a car accident heading south on I-5 just north of the Sunset Exit in Bellingham. A semi came into our lane hitting the back driver's side of our car and sending us spinning from the right lane across the left lane and onto the median strip. Some new cable fencing had just been constructed down the center of that section of the median within the last few months. It may have saved our lives by tangling us up and keeping us from going into the northbound lanes of traffic. We spun around many times but were basically unharmed as we suffered no direct impact with hard objects. The car was totalled but we were amazed and grateful to be alive. Many thanks for whatever part you played in getting the fencing installed. In our case it was an excellent safety measure."

e-mail from a resident involved in a cable barrier crash

Accident History

The before and after accident history is shown in the table. While the accident data shows that the number of accidents increased noticeably, the number of severe accidents (fatal and disabling) decreased significantly. This resulted in a societal benefit of cable median barrier calculated to be $420,000 per mile annually.



Given the societal benefits associated with the use of cable median barrier at locations having prior cross median accidents, cable median barrier has been found to be a cost effective solution to median crossover accidents.

Median Accidents Before the Installation of Cable Barrier

	Annual Accidents	Accident Rate (100 mvmt)*	Annual Fatal Accidents	Annual Disabling Accidents	Annual Societal Costs (all severities in millions)
All	49.00	6.50	3.00	3.60	$13.58
Fixed Object	25.60	3.40	0.60	1.00	$6.45
Cable Barrier	na	na	na	na	na
Rollover	11.40	1.51	1.00	1.20	$4.50
Crossover	16.00	2.12	1.60	2.20	$7.13

Median Accidents After the Installation of Cable Barrier

	Annual Accidents	Accident Rate (100 mvmt)*	Annual Fatal Accidents	Annual Disabling Accidents	Annual Societal Costs (all severities in millions)
All	100.43	13.35	0.33	1.76	$3.32
Fixed Object	91.71	12.17	0.33	1.76	$2.48
Cable Barrier	58.56	4.05	0.33*	0.88	$3.44
Rollover	9.40	1.25	0.33	0.65	$1.71
Crossover	3.83	0.51	0.00	0.33	$0.18

Across the median crashes are high severity, often fatal crashes occurring when errant vehicles cross the median and enter the opposing lanes of travel.

Guidelines for the installation of median barriers presented in the AASHTO Roadside Design Guide (1) were developed in the 1960's. In the early 1990's the Washington State Department of Transportation (WSDOT) became interested in installing barrier in medians that exceeded the AASHTO guidelines where there was a history of cross median accidents.

A study of across the median crashes on Washington's multilane, divided state highways, with full access control, was conducted to evaluate median barrier guidelines and identify specific highway sections where installation of a barrier is desirable (2).

"...credit should be given to WSDOT for installing the cable median barrier that prevented the vehicle from entering the opposite lanes and likely saved multiple lives."

excerpt from a letter from FHWA Division Administrator Dan Mathis in regard to a cable barrier crash.

A safety analysis was conducted to evaluate the cost effectiveness of median barrier installation. The analysis was used to develop revised guidelines for median barrier installation. In addition, the benefit/cost methodology provides a means for ranking median barrier needs based on past crash history. This ranking will allow these improvements to compete for safety improvement funds within Washington State as a system wide safety initiative.

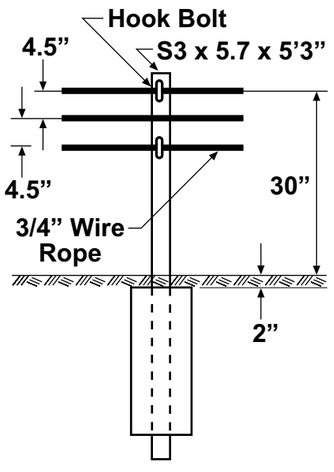
Based on this safety analysis the Benefit/Cost ratios shown in the following table were calculated for installing barrier in medians of varying width. Policy was adopted to install barrier as part of Improvement projects when the median width is 50' or less. While the installation of a barrier in median over 50' in width may have benefits, it was decided that this investment would need to be weighed against other improvements on a case-by-case basis.

Median Width	Cable Barrier	Guardrail	Concrete Barrier
Under 30"	2.7	1.9	1.1
30-40'	5.5	3.9	2.3
41-50'	4.7	3.3`	2.0
51-60'	3.2	2.3	1.4
61-70'	0.6	0.4	0.3
71-80'	0.8	0.6	0.4
Over 80'	2.3	1.6	1.0

Washington State Department of Transportation

Cable Barrier

Cable barriers have been used on the nation's highways since the 1930's or before. The modern system, which uses 3 cables supported by weak steel posts was developed in the 1960's and has been used significantly by several states. Since 1989, the American Association of State Highway and Transportation Engineers (AASHTO) *Roadside Design Guide (1)* has contained information on a cable median barrier design that mounts the middle cable on the back side of the posts so that it can contain and redirect vehicles that strike the system from either side. Cable median barrier has been tested in accordance with NCHRP Report 350 Test Level 3 *(3, 4).* However, there have been only a few studies published about the in-service performance of this system. The WSDOT conducted a study of this barrier performance (5) and the results are summarized as follows:



Typical cable median barrier installation and details

Initial Costs

Quantifying the differences in the various systems' initial costs was accomplished with the aid of the WSDOT Unit Bid History. Unit bid prices do not include mobilization, traffic control, and engineering. This system was used to find the state average bid price for cable median barrier, precast concrete barrier, W-beam guardrail, cast in place and single slope concrete barrier:

- Cable median barrier: $8.33/ft or $44,000/mi
- W-beam guardrail: $13.65/ft or $72,000/mi
- Precast concrete barrier: $24.64/ft or $130,000/mi
- Single Slope concrete barrier: $44.94/ft or $237,000/mi
- Cast in Place concrete barrier: $79.36/ft or $419,000/mi

Costs for cable barrier terminals are about the same as guardrail terminals – roughly $1,700 so they do not appear to be a relevant fixed cost factor. If an impact attenuator is used to terminate a guardrail or concrete barrier, the terminal costs can be much more expensive.

1- American Association of State Highway and Transportation Officials: Roadside Design Guide, Washington, DC, 1989

2- Median Treatment Study of Washington State Highways, Glad-RW, Albin-RB, McIntosh-DM, Olson-DK, Washington State Department of Transportation Report WA-RD 516.1(March 2002), http://www.wsdot.wa.gov/eesc/design/policy/pdf/MedianTreatmentStudy.pdf

3- Washington State Cable Median Barrier, Albin-RB, Bullard-DL, Menges-WL, Transportation Research Record 1743 (2001) pp 71-79, http://www.wsdot.wa.gov/EESC/Design/Policy/RoadsideSafety/PdfFiles/CableBarrierReport.pdf

4- Ross-HE Jr.; Sicking-DL; Zimmer-RA; Michie-JD: Recommended Procedures For The Safety Performance Evaluation of Highway Features, Transportation Research Board, National Cooperative Highway Research Program (NCHRP) Report 350, Washington DC, 1993.

5- Washington State Cable Median Barrier In-Service Study, McClanahan-D, Albin-RB, Milton-JC, Presented at TRB Annual Meeting, January 13, 2004. http://www.wsdot.wa.gov/eesc/design/policy/pdf/CableBarriersubmittalforTRB.pdf

The table below summarizes average, minimum, and maximum cost for all cable median barrier accidents identified by maintenance reports on I-5. Total repair costs include parts, labor, and equipment costs. Hours for repair are stated in person-hours:

	Max.	Min.	Avg.
Number of posts hit	32	1	6.7
Hours for repair	70	1	9.4
Parts cost	$1,490	$32	$328
Total repair costs	$2,822	$72	$733

Maintenance cost per mile was found to be $2,570 annually.

Maintenance

The WSDOT maintenance staff generates repair reports for many facility specific hardware items. These maintenance reports are categorized by items such as guardrail, cable, and concrete barriers. Quantifying cable median barrier maintenance cost was accomplished by tracking these maintenance reports. Maintenance staff compiled 141 cable barrier related maintenance reports for cable barrier damage on I-5 during the cable median barrier study period.

"We were initially opposed to the cable barrier installation in our area. We now support additional cable barrier in our Region, and are considering taking on some cable barrier installation work in conjunction with our Traffic Office."

comment from a Maintenance employee